

1.0 INTRODUCTION

- o Unconsolidated materials underlying the site
- o Site hydrogeology, including the ground water flow direction and rate
- o Extent and depth of existing subsurface contamination.

This 4.4-acre (estimated) site was purchased from the Benjamin Moore Company in 1962 and current operations were started in 1963. The facility has been primarily used for bulk storage and repackaging since that time; however, from 1969 to 1984, anhydrous ammonia was processed to ammonia.

280442



- o Aromatic hydrocarbons
- o Aliphatic hydrocarbons
- o Petrochemicals
 - Alcohol
 - Chlorinated solvents
 - Esters
 - Glycol
 - Glycol ether
 - Glycol ether esters
 - Ketones
 - Surfactants
 - Plasticizers
 - Silicones.

Can this be broken down into approx. 70%?

The site includes a packaging facility in the northern portion of the property, a driveway area and parking lot with a tank truck loading terminal, and an oil/water separator unit about 40 feet east of the terminal. The property is bounded by Noes Creek to the south, New Jersey Branch railroad tracks to the west, Roosevelt Avenue to the east, and the now or former Wheeler Condenser and Engineering Company to the north. An additional railroad track spur extends from the southwest to the northeast through the facility.

2.0 FIELD INVESTIGATION

2.1 EMERGENCY RESPONSE FIELD ACTIVITIES

Union Chemicals requested emergency response assistance on June 26, 1985 to contain product entering Noes Creek from a seep (Seep 1) south of the plant area (Figure 2). IT responded to their request to contain and collect seepage by placing a number of absorbent booms, both up- and downstream, across the creek, placing absorbent packs into sumps hand dug at the seep, and by excavating a suspect drain pipe found at the point of the seep. The excavation continued from the original point of the seep to just north of the concrete curb where a large pit was excavated. Product was observed seeping into this pit at several locations. A vacuum truck was used to collect the product and associated contaminated water which was then pumped into Union Chemicals storage tanks on site. Soil and water samples were collected from the area of the seep and analyzed for xylene, toluene, and benzene (Tables 1 and 2). A second seep was observed during these field activities approximately 60 feet east of the first seep (Figure 2). A sump was dug at the point of this seep

why?

and packed with absorbent material. The second seep prompted additional investigation to better define the existing problem.

how deep? ~ have to go to illustrations to get depths.
Four test pits were excavated along the southern perimeter curb of the parking lot and driveway (Figure 2). During excavation of Test Pits 1, 2, and 3, product was observed seeping from the subsurface soil walls. One composite soil sample was collected from each of the four pits. Samples from Test Pits 2 and 4 were analyzed for volatile organics compounds (Table 2). A water sample was also collected from the bottom of the vacuum truck (Table 1). Soil classifications for these pits are presented in Appendix A.

The results of analyses from soil and water samples collected during the emergency response and additional investigation activities were used to design the work plan for the site assessment described in the following sections of this report.

2.2 DRILLING AND SOIL SAMPLING

→ Thirteen six-inch-outside-diameter soil borings were drilled to selected depths through surface fill and into natural subsurface soils (Figure 2). Soil samples were collected continuously from the borings using a two-inch-outside-diameter split-barrel sampler which was decontaminated between samples using detergent followed by clean rinse water. The sampler was driven ahead of the augers by a 140-pound hammer dropped 30 inches to provide Standard Penetration Test data (American Society for Testing and Materials [ASTM] Procedure D1586). Soil sample composites were collected from each two-foot interval starting at the ground surface. The soil samples were placed in clean, 500-milliliter, sealed amber glass jars. [Two 40-milliliter volatile organic analysis (VOA) vials were also collected for each sample.] Head space measurements for volatile organics were made from the jars with an organic vapor analyzer (OVA) to assist in characterizing soil contaminant levels (Table 3). All soil samples were shipped with appropriate chain-of-custody forms to the IT laboratory in Export, Pennsylvania for analysis and archiving. A log describing both the visual classification of the soils and drilling conditions was prepared by the IT field geologist (Appendix A). Drill cuttings and other wastes were drummed upon completion of each hole and properly disposed of later with other wastes derived from the initial emergency response activities at the Waste Conversion landfill.

How were they "Selected"? What criteria used?

See P. 4

See P. 8
does this mean OVA was done on amber jar sample? why then collect vials? Was soil put in vials?

2.3 MONITORING WELL INSTALLATION AND DEVELOPMENT

Monitoring wells were installed in 12 of the borings to allow ground water samples to be collected for chemical analysis and to provide water level information necessary to assess the direction and rate of ground water flow. The wells were constructed of two-inch-inside-diameter Schedule 40 stainless steel pipe with flush threads and 0.010-inch slotted stainless steel screens. A filter pack of coarse silica sand was placed in the annulus around each well screen and a bentonite seal was installed above the filter pack to impede the infiltration of surface water into the well. The remaining annulus between the borings and riser pipes was then grouted to ground surface with a mixture of cement and bentonite. A locking cap was installed on the riser pipe and eight-inch steel lamp hole covers were cemented in place around the riser pipe and set level with the ground surface. Well completion diagrams are presented in Appendix B.

The wells were developed by pumping with a diaphragm pump and flushing to remove fines from the area around the sensing zone to enhance communication between the water-bearing zone and the well. All water collected from the wells was placed in drums and later transferred to the Union Chemicals on-site storage tanks. All downhole well completion equipment was decontaminated between holes with hexane washes and distilled water rinses. The decontaminating fluids were collected and placed in the Union Chemicals on-site storage tanks.

what was used
criteria used
to determine
that wells
were "developed"
Important!

2-way flow?

how long?
to what extent?

why a
different
cleaning
method
from
p.3?

2.4 MONITORING WELL ELEVATION AND LOCATION SURVEY

A survey was conducted of the installed monitoring wells by Goodman, Allgair, and Scott, a local, registered surveyor, to provide both vertical and horizontal control for water levels, samples, and geologic data. The Union Chemicals facility itself is surveyed horizontally to the New Jersey State Plane Coordinate System and vertically to the U.S. Geologic Survey elevations. Well locations and pertinent elevations are shown in Figure 2 and Table 4, respectively.

Are MW 2 and 7 confined?
The rest I assume
are unconfined.

2.5 WATER LEVEL MEASUREMENT

Measurements of ground water levels in the monitoring wells were taken on three different dates and at five different times (Table 5). The water levels

you haven't defined "the aquifer" adequately yet. →
were obtained at varying times in an attempt to define ground water gradients at the site under varying tidal conditions. It was concluded, however, that proper evaluation of the tidal influence on the site ground water gradient would require installation and operation of several continuous water level recorders for a period of at least two weeks.

Good point! I would keep recorders in service, however, as long as any symptomatic measurements are to be made!

2.6 GROUND WATER SAMPLING AND ANALYSIS

Water samples were collected from each of the monitoring wells using a 1.05-inch-outside-diameter point source bailer. The samples were collected in order from the cleanest wells to those with the greatest accumulation of product. The sampling method was designed to determine whether or not volatile organic contaminants were stratified in the aquifer. Samples were collected separately from the top and bottom of the water column in Wells 5, 6, 8, 9, 10, and 11. Only the top of the water column was sampled in the remaining wells. The monitoring wells were not purged immediately prior to collecting samples to avoid disturbing any stratification of dissolved contaminants in the aquifer or the formation of free-phase product layers. Free-phase product was observed in Monitoring Wells 5, 6, and 8 at the top of the ground water table. Sample temperature, pH, and specific conductance were measured and recorded for each sample in the field. Ground water samples were placed in appropriate sealed containers with appropriate chemical preservatives and cooled to wet ice temperature (4 degrees Celsius) for delivery to the IT analytical laboratory. Chain-of-custody forms were completed and shipped with the samples. The bailer was decontaminated between wells with hexane and distilled water which was collected and placed in the Union Chemicals on-site storage tanks. (over)

based on CVA analysis? visual observation? what?

See comment (over)

good → All samples were analyzed for volatile organic compounds. Samples from Wells 1, 5, 8, and 12 were analyzed for chloride, sulfate, and alkalinity. The results of all analyses are presented in Table 6.

was there a limitation on non-prioritized pollutants?

2.7 HYDRAULIC CONDUCTIVITY TESTING

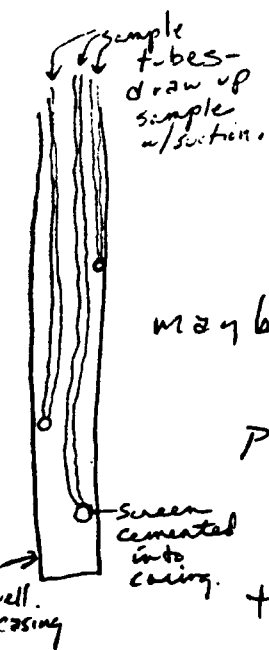
In situ rising head permeability tests were conducted in Monitoring Wells 1, 4, 6, 7, and 12 following ground water sampling to determine well sensitivity (degree of communication between the well and the water-bearing zone) and the hydraulic conductivity of the water-bearing zone. The tests were conducted by

not of much value is a 2" well. with this type of well, you are probably measuring the k of the gravel/sand pack!

The only concern I have involves the use of the 1" ID Point-source bailers. Two problems come to mind in attempting to obtain an "undisturbed" sample using this method:

① If a multi-phase system exists, where oil is sitting on top of the saturated zone, the ^{interior of the} point-source bailer must be exposed to the oil layer. This will likely result in the transport of oily material down to the lower sampling interval, ~~thus~~ maybe producing artificially high contamination levels in the lower sample. This problem could be partially eliminated by use of a syringe-type sampler. Best method is to install multi-point piezometers built into casing (see drawing).

② After making the first trip into the well with the bailer, the ^{rest of the} water column will likely be disturbed in the well anyway due to the piston-effect of the 1" bailer in the 2" ID borehole.



These concerns may have an effect on any attempt to define vertical stratification of contaminants, I would tend to discount any conclusions in this area.

In general, though, the sampling protocol appears to be acceptable.

(Comments on p. 5)

lowering the water level in the well below the ground water table and measuring the subsequent rise in water level as a function of time. The results of the permeability testing are presented in Table 7.

2.8 STREAM SEDIMENT SAMPLING

Two sediment samples were collected from Noes Creek (a low gradient tidally influenced stream); one from sediments upstream of the plant and the second from sediments downstream of the plant (Figure 2). The purpose of collecting these samples was to provide a preliminary determination of the plant's impact on Noes Creek sediments. The samples were collected with a hand trowel at the surface of the stream bottom sediments. Samples were placed in clean, amber glass jars and shipped to the IT laboratory for analysis. Results of the analysis are presented in Table 8.

3.0 RESULTS OF INVESTIGATION

3.1 SITE GEOLOGY AND HYDROGEOLOGY

The Union Chemicals facility is constructed on relatively level fill material emplaced on irregular, unconsolidated sedimentary deposits. Cross sections were constructed from the borings logs and are presented in Figures 3, 4, and 5. The locations and orientations of the sections are shown in Figure 2.

Fill deposits range in thickness from zero to at least 15 feet beneath the site and are composed of fine to coarse sands with some gravels, clay, bricks, concrete, metal, glass, and slag. Beneath the fill are irregular deposits of sands, clays, silty clays, silt, and peat. It appears that older sand and clay deposits have been partially eroded and the depressions filled in with younger deposits of peat, clays, and sands. This reworking of sediments was probably the result of meandering and ensizing by Noes Creek.

Ground water elevation data were collected at five different times and tidal stages (Table 5). The data show fluctuating water levels which may be associated with tidal changes. The total change in ground water level and lag time at each well due to tidal influence cannot be determined from the present data base. It may be necessary to install and operate several continuous ground water level recorders for a short time period to obtain the data required for evaluation of remedial action alternatives.

not true - 30% of measurement tables showed an upward gradient!
with water
Generally, the ground water flows from north to south across the site (Figure 6). The water table contours were developed from the average of the last four water level measurements, excluding deeper Wells MW-7 and MW-2. ✓

Water levels in two well groups, MW-1 and MW-2 and MW-6 and MW-7, show a downward ground water gradient in the sediments. The ^{vertical?} gradient is slight but consistent at these two sites. Actual vertical gradients may be greater beneath the site; the measured magnitude is likely reduced from actual conditions by the size of the sensing zone established by the long length of screen in the wells.

Permeability test results indicate that the fill, sand, and clay deposits have ~~low~~ to moderate hydraulic conductivities (Table 7).

Assuming an average ground water gradient of 5 feet/330 feet, an average hydraulic conductivity of 3×10^{-5} feet per second (9×10^{-4} centimeter per second), and a porosity of 0.4, the average ground water velocity was calculated to be about 1×10^{-6} feet per second, or about 32 feet per year. This value was calculated using the following equation:

Seems to be high ^{was} 0.3?
cm²

$$v = \frac{ki}{\theta}$$

$$\frac{3 \times 10^{-5} (5/330)}{.3} = 1.6 \times 10^{-6} \text{ CPS}$$

(50.8 PY)

where

k = average hydraulic conductivity,

i = average horizontal ground water gradient perpendicular to the direction of ground water flow, and

θ = assumed representative porosity.

3.2 ANALYTICAL RESULTS

Stop
Elevated concentrations of volatile organics were detected in water and soil samples during the initial emergency response program (Tables 1 and 2). Additionally, free product was observed flowing into Test Pits 1 through 3 and at the water table in Monitoring Wells 5, 6, and 8. Water samples collected from seeps contained 8,200 parts per billion (ppb) benzene, 7,700 ppb toluene, and 100,000 ppb total xylenes. Soil samples collected from the area adjacent to the seep had a benzene concentration of 200 ppb and total xylenes of 440 ppb.

Table 2 also indicates the levels of volatile organics which were detected in soil samples from Test Pits 2 and 4. Test Pit 2 evidenced higher concentrations of all parameters analyzed than Test Pit 4, with the exception of ethylbenzene and total xylenes. The Test Pit 2 soil sample contained ~~significant~~ concentrations of:

- o Chlorobenzene
- o Methylene chloride
- o Tetrachloroethylene
- o 1,1,1-trichloroethane
- o Acetone
- o Total xylenes.

Why would TP2 be so dirty, while adjacent WT well MW3 had only a trace of contamination?

The Test Pit 4 soil sample contained ~~significant~~ ^{over 100 ppb} concentrations of chlorobenzene and total xylenes.

During the drilling operations, head space measurements of volatile organics were conducted on soil samples which had been placed in glass jars. The results of the measurements indicate that organic materials are present throughout the sampled soil columns (Table 3). The type of OVA used for these determinations was of the ionization type so that methane gas, if present, did not influence the readings.

See comments on T-3

The ground water collected from the 12 monitoring wells was analyzed for all volatile priority pollutants and selected volatile nonpriority pollutants. Table 6 is a summary of pollutants detected in the water samples. The significant contaminants appearing on this list which have the potential for the greatest health risk are:

define "significant" - buzzword

- o Benzene
- o Chlorobenzene
- o Methylene chloride
- o Tetrachloroethylene
- o Trans-1,2-dichloroethylene
- o 1,1,1-trichloroethane
- o Trichloroethylene.

Significant ^{that are over} ~~(greater than 100 ppb)~~ concentrations of these contaminants were found in Monitoring Wells 4 through 11.

Volatile organics were not detected in the sediment samples collected from Noes Creek.

4.0 QUALITATIVE RISK ASSESSMENT

4.1 INTRODUCTION

A hydrogeologic investigation of the Union Chemicals site located in Carteret, New Jersey has indicated the presence of several volatile organic chemicals in the ground water beneath the facility. This qualitative risk assessment will provide a preliminary appraisal of the health risks and environmental impacts associated with exposure to those chemicals in site-specific circumstances.

The fundamental concept of the risk assessment stipulates the requirement of a hazard and an exposure to that hazard before a health risk or environmental impact can occur. A completed exposure pathway is inferred, which includes three necessary components: (1) a source--the presence of contaminants having known toxicological characteristics; (2) an exposure pathway--actual or potential pathways that are complete; and (3) receptors--human and environmental receptors in the exposure paths. The hydrogeologic study has established the presence of the hazardous constituents and provides preliminary data to evaluate the potential exposure pathways.

High levels of monocyclic aromatic hydrocarbons (benzene, chlorobenzene, ethylbenzene, toluene, and xylene) and halogenated aliphatic hydrocarbons (tetrachloroethylene, 1,1,1-trichloroethane, and vinyl chloride) were detected in site ground water and surface seepage samples. A nonaqueous phase liquid (NAPL) flow condition, evidenced by the presence of a product layer above the aqueous fraction of the seeps and ground water samples, was observed during the emergency response and hydrogeologic investigation phases of this project.

Based on the geographical and topographical distribution of potential human receptors and environmental biota, a preliminary estimate would indicate a low potential for human exposure and a high possibility of impacts on environmental biota, to the extent they are present in Noes Creek and the Arthur Kill.

4.2 CONTAMINATION CHARACTERIZATION

The contamination pattern of volatile organic constituents found on site can be characterized by the presence (or absence) and concentrations of selected indicator chemicals in the individual environmental media samples and by evaluation of the spatial distribution of contaminants.

Volatile organic contamination of ground water was chosen as the primary site investigation focus due to the following:

- o The bulk of the materials handled at the facility and the materials known to have been released in the past or detected in ground water during the emergency response phase of the project are volatile organic compounds.
- o Volatile organic compounds are generally highly mobile in soils due to high volatility (as indicated by vapor pressure), have high water solubility, and low capacity for soil adsorption (soil adsorption coefficient); therefore, permanent soil and sediment contamination by volatile organics should be minimal as compared to current levels of ground water contamination.

this is why
VOC's are not
seen in river
bed material?

4.2.1 Probable Contaminant Source

High concentrations of volatile organic chemicals were found in the ground water and seeps (aqueous and nonaqueous fractions) collected at the site. The observed pattern of contamination and the resulting hypothesized sources depend to some extent on the placement of the monitoring well. This dependence results from the necessity to infer contamination patterns between the monitoring wells.

what kinds
of materials
were stored here?
Aromatics??

It appears that past spills and leakage has occurred from the tank farm located in the northwest section of the site. Monitoring Well 12 is an on-site upgradient well that has some utility as the background descriptor. Monitoring Wells 1 to 3 may also be monitoring background water quality, or are located outside of the contaminant plume. The ground water in these wells does not appear to be impacted at the present time. Major chemical constituents in the contaminated ground water plume emanating from the tank area are monocyclic aromatic hydrocarbons (MAHs). Indicator constituents in this category are benzene, chlorobenzene, ethylbenzene, toluene, and xylene.

Same?

not sure!

TP2 was dirty!

based on what?
MW 9+10?

there are VOC's in all
4 well samples,
though. See
MW 2 det

They should not use un-
evident. Dist. in
to tell what in
these tank farm
this is the

Halogenated aliphatic hydrocarbon (HAHs) display a different distribution pattern among the analyzed samples and the location of the sampling points. They appear to have emanated from the tank farm in the center of the Union

Chemicals facility. This is based on the absence of these particular contaminants in the ground water in the vicinity of the northwest tank farm. The

HAHs selected as indicator chemicals for this site are tetrachloroethylene (PCE), 1,1,1-trichloroethane commonly known as methyl chloroform (MC), and vinyl chloride (VC) probably resulting from biodegradation of the PCE.

I'm not
so sure
that the
distribution
differs
greatly
from the
Aromatic

It must be emphasized that the above conclusions relating to the probable sources are based on limited background information and a small chemical analytical data base.

Very true. The company should be able to provide data on tank storage!! 3 HAH's? why only these from GW data?

4.2.2 Characterization of Extent of Contamination

This description of the extent of contamination is intended to provide a framework for assessment of exposure to hazardous constituents migrating from the site. Since the chemical analytical data base is essentially limited to volatile organic contaminants detected in the ground water, the character of the other environmental media, i.e., ambient air (on and off site); soils (surficial and subsurface), in the unsaturated and saturated zone; surface water in Noes Creek and Arthur Kill; and creek sediments, cannot be directly evaluated. Appraisal of the likely extent of contamination of these environmental media is based on the limited background information and site investigation data available.

Ambient Air

The quality of on-site ambient air is unknown. However, the presence of volatile organics at relatively high concentrations in the ground water, the very shallow unsaturated zone above the ground water table which potentially provides a link between the air and ground water through capillary action, and contaminated seeps on site would indicate some impact on ambient air quality.

Poorly
written

Volatile organic constituents are volatilizing from ground water, possibly contaminated soils (actual levels are unknown; high OVA readings were observed during soil disturbance when excavating the test pits) and contaminated surface waters of Noes Creek. The ambient air levels of benzene are probably

What testing
was done to
show this?

elevated above background and could be at concentrations on the site that pose some risk upon exposure. All of the other contaminants, i.e., chlorobenzene, ethylbenzene, toluene, and xylene, will most likely also be elevated above background levels but are not expected to reach concentrations associated with health risks. None of the HAHs, although they will volatilize, are expected to be present above background levels. Vinyl chloride will evaporate readily at ambient temperatures, but detectable incremental elevations in concentrations are not likely due to the low levels detected in site ground water.

what a
fussy
phrase

Undetermined semivolatile organics and inorganic constituents, if any, would not volatilize to the extent necessary to impact ambient air quality. True.

Soils

There is only a very limited chemical analytical data base available to estimate the extent of soil contamination. Based on the behavior of chemicals in the environment, the list of chemical products handled at this facility, and the presence of a NAPL flow condition, the following limited characterization may be applicable to this site:

only
a
generalized
list!

- o Presence and levels of volatile organic contaminants (found in the ground water) in the soils will be limited unless bulk dumping has occurred in the past or there is an ongoing contaminant release. Volatile organics are highly mobile in soils due to their ability to evaporate to air, high solubility in water, and low soil adsorption capability. ✓
- o Phthalate esters, polycyclic aromatic hydrocarbons (PAHs), and halogenated ethers may be present at significant levels in the soils in the unsaturated and saturated zones. The reported product mix and presence of a nonaqueous fraction (which is mainly organic solvents) would enhance the mobility of these relatively immobile chemicals in the soil and water media. However, there are no data available to determine the validity of this premise.

Ground Water

There appears to be both vertical and horizontal migration of the volatile organic constituents found in the ground water. This is likely due to the behavior of these particular chemicals in the environment. Vertical stratification of contaminants in some of the wells is apparent; lower specific

your data
doesn't show
that!

gravity compounds were found in higher concentrations in samples taken from the top of the well. This may be due to gravity separation or could be due to a mixing of the NAPL solution in the upper sample.

The lighter MAHs appear to have migrated from the northwest tank area. The highest concentrations were found downgradient at this area in Monitoring Wells 6 and 8. Benzene and chlorobenzene were observed at the highest concentrations (benzene at 85,000 micrograms per liter [ug/l] maximum; chlorobenzene at 230,000 ug/l maximum) and with the highest frequency (15 positive detections in 16 samples). Only the MAHs (benzene, chlorobenzene, ethylbenzene, toluene, and xylene) and methyl chloroform have moved to the deeper part of the aquifer as indicated by the analytical results from the Monitoring Well 7 deep well sample. *1,1,1-Trichloroethane (be consistent in terminology!)*

The contaminant plume appears to be confined to a relatively limited area.

Monitoring Wells 1 through 3 do not appear to be in the influence of the plume at this time.

Relative to potential exposure to contaminated ground water, it should be noted that:

- o The dominant ground water flow direction is toward Noes Creek and Arthur Kill. This is away from the greatest concentration of human receptors located northwest of the site. Consequently, the potential for exposure to significant levels of volatile organic pollutants in ground water by ingestion is very low. This premise is valid whether the ground water is or is not being used for drinking purposes. There are, however, no known users of shallow ground water in the area of the site.
- o Because there are no available data regarding semi-volatile organics that may be present in the ground water due to the NAPL conditions, the potential impacts due to ground water discharge to surface water cannot be evaluated.

Surface Water

There is a very limited available data base to characterize the contamination of surface water, i.e., Noes Creek and Arthur Kill. Seeps and ground water accumulated in the test pits are defined as ground water for the estimation of

health risks and environmental impacts. Evaluation of surface water quality was not an objective of the first phase of the hydrogeological study.

VOE in near-shore areas of Nees Creek should have been looked at. Quality was? when is the rationale?

A clear understanding of the environmental fate of the site contaminants is essential for estimating health and environmental impacts. The volatile organics in the ground water will be essentially volatilized at the surface water/ambient air interface. The most likely potential impacts on environmental and human receptors will be from migration of semivolatile organic pollutants in the nonaqueous fraction of contaminated ground water to both surface water and sediments. Semivolatiles that are solubilized in the nonaqueous phase could adsorb to colloidal particles in surface water and settle to the bottom in the sediments. There, they would be available to aquatic biota if biota are present. Some toxic constituents, i.e., PAHs, if they are present, could move up the food chain by bioaccumulation and biomagnification to result in significant potential exposure.

The extent of surface water contamination is unknown. Attenuation of volatile organic contaminants by evaporation and the unlikely possibility of impacted surface water being used as a potable water source (it may be brackish or sea water) may preclude exposure by human receptors. Transfer of volatile organics to ambient air is not expected to result in significant levels due to the great opportunities for attenuation by advection and dispersion in the open atmosphere.

4.3 EXPOSURE PATHWAYS

An exposure pathway is the route a contaminant may take to reach a susceptible receptor. For an exposure pathway to be complete, three factors must be present: a source of contamination, a route of contaminant transport, and an exposure of an environmental or human receptor to the contaminants. The mode of exposure and its duration also influence the impacts. Modes of exposure are usually categorized as inhalation, ingestion, and dermal (direct contact). There may be indirect exposures by ingestion of contaminated foods and by dermal and inhalation during recreational use (wading, fishing, and boating) of surface waters. Exposure durations are separated into two main classes, i.e., acute, which is of short duration and frequency, and chronic, which implies long-term (months and years) and continuous or frequent exposure.

4.3.1 Ambient Air

All of the detected contaminants are volatile organic constituents; consequently, all will evaporate at the soil/air and surface water/air interface to result in incremental increases in levels above background. The only potential exposure to toxicologically significant levels of the most critical contaminant (benzene) will be on site. Advection and dispersion would attenuate vapor concentrations to safe levels at the nearest off-site human receptor locations.

4.3.2 Soils

Surficial Soils

The relatively difficult access to the industrial area in which the site is located (the presence of a railroad track and perimeter fencing separating the residential area from this site) will minimize the trespass of children and third-party intruders. Consequently, only on-site personnel will be considered to be the potential receptors due to direct contact with or ingestion of contaminated surficial soils. Therefore, direct contact with contaminated surface soils is not considered to be a potential exposure path.

Subsurface Soils

Exposure to contaminants that may be present in the deep soils by direct contact is not expected to be a viable exposure pathway. Deep soils may serve as a conduit to transport volatile organics, and potentially semivolatile organics mobilized in the NAPL, to ground water.

Migration of volatile organics from the unsaturated zone to ambient air will elevate ambient air concentrations, but significant concentrations are not expected on site and are very unlikely at any off-site receptor location.

4.3.3 Ground Water

Ingestion of contaminated ground water is not expected to be a critical exposure path at this site. *super system unknown!!!* All of the ground water beneath the site is flowing away from the closest cluster of homes (supplied by a city water system). Ground water discharges from the site into Noes Creek very rapidly reach Arthur Kill. Both bodies of water are subject to salt water intrusion making local surface water an unavailable source of potable water for the nearby residents.

Indirect exposure to some contaminants, if the volatile organics are not attenuated, during recreational use of Arthur Kill is possible. However, the industrial character of the surrounding area and the presence of a large active landfill and marsh on the Staten Island side of the Kill would deter recreational use of the surface water in the impacted area.

4.3.4 Surface Water

Surface waters may be impacted. There are no available data to determine whether volatile organic contaminant attenuation is occurring. If semivolatile organic constituents are entering the Creek and Kill they would accumulate in the bottom ^{and suspended} sediment. Consequently, there could be some potential for uptake in the food chain with subsequent exposure of human receptors due to ingesting contaminated aquatic food. The volatile organics do not bioaccumulate to any great extent. ^(reference) The most likely exposure path would be associated with semivolatiles that may be mobilized in the NAPL and transported by ground water discharges and surface seeps to Noes Creek.

Semi-Volatiles + non-volatiles not evaluated

4.3.5 Environmental Impacts

The most toxic class of contaminants in the context of aquatic toxicity is the inorganic constituents. This does not appear to be a problem at this site. B.S.

where did this statement come from?

The low conductivity of the ground water samples is indicative of low dissolved solids and an absence of ionic activity in the water. Volatile organics will be attenuated due to evaporation of the surface water/air interface.

2 never looked for!!!

In addition, most of them are not acutely or chronically toxic to aquatic biota at the expected surface water concentrations. The introduction of pollutants from the landfill that have high associated biological and chemical oxygen demand may affect the dissolved oxygen levels in the creek and Arthur Kill to result in adverse effects on the aquatic biota (if they are present).

Pure speculation

4.4 RECEPTORS

The following potential human receptors may be present in the vicinity of the site:

- Users of ground water for drinking purposes - None known in the area surrounding the site

Pb and paint plant would not show up on TDS!

- o Users of surface water for recreational purposes -
Dermal exposure during swimming and boating (inadvertent dermal exposure) and inhalation of volatilized organics
- o Persons trespassing on site and coming in direct contact (dermal exposure) with contaminated soils and ground water (seeps) on site
- o Persons coming in contact with contaminated sediment and surface soils that may have migrated off site in surface runoff
- o Persons inhaling volatilized organic vapors that are mobilized by wind erosion
- o Persons consuming contaminated aquatic food that has bioaccumulated and biomagnified contaminant levels.

Environmental receptors include:

- o Aquatic biota that are exposed to organic contaminants with associated bioaccumulation and biomagnification characteristics
- o Surface waters that may be adversely affected to limit their use for any purpose
- o Wetland and marsh ecologies that are very fragile and will be adversely altered by introduction of chemical contaminants.

The identification and characterization of the above receptors was not an objective of the first phase of this investigation. Based on the topographical and geographical character of the site and the surrounding area, as interpreted from the USGS map, the presence of the above receptors at locations where significant impacts may be possible is not a high probability at present or at some future time. ??

4.5 HAZARD IDENTIFICATION

The identification and characterization of hazards associated with the site is based on the presence and concentration of chemicals found. Consequently, this hazard characterization is based on volatile organic compounds detected in the ground water beneath the site.

The following criteria are used to select the indicator contaminants for the risk assessment:

- o Toxicity - If the contaminant has associated biological health impacts, i.e., carcinogenicity or development effects, it should be included as a contaminant of concern. Acute and chronic systemic toxicity has an implied threshold level; consequently, other criteria must be used in conjunction with toxicity.
- o Concentration levels - Constituents detected at high concentrations in the environmental media should be included if they are prevalent.
- o Prevalence is defined by the frequency of positive detections in the collected samples and the character of the contamination pattern.
- o Persistence in the environment.

Table 9 provides a summary of the pertinent factors for categorizing the detected contaminants.

Benzene, vinyl chloride, and PCE are classified as suspect animal or human carcinogens. They were found frequently, especially benzene, in the ground water samples at significant concentrations. Consequently, all were included as indicator contaminants.

Ethylbenzene, toluene, methyl chloroform, and xylene, which have exhibited systemic toxicity with associated thresholds, were detected frequently to indicate a high prevalence in the ground water. They were selected as indicator contaminants for the risk assessment.

Chlorobenzene was classified as an indicator chemical due to the very high concentrations found on site. Since it does not possess any toxicological properties, it was considered to be a precursor of benzene and xylene and was used to define the extent of contamination. *what is being said here?*

Although chloroethane was frequently detected in the ground water samples and the maximum concentration of 1,600 $\mu\text{g/l}$ was considered to be an anomaly (the next highest value was 67 $\mu\text{g/l}$) the concentrations are not considered to be significant. This evaluation is based on the low toxicity of this compound by

nonsense. US EPA suggested limit in water to protect human health is 485 ppb known to cause liver damage

the ingestion route and its chemical nature, i.e., it is a gas at normal temperatures. 1,1-dichloroethane and 1,2-trans-dichloroethylene were also detected frequently. However, at the concentrations measured exposure is not likely to cause a health impact. *No criteria have been yet established because of insufficient data*

Ketones (acetone, 2-butanone [methylethyl ketone]) and styrene were found less frequently. However, at the reported concentrations, exposure is not expected to result in any adverse health impacts due to the relatively low systemic toxicity of these compounds.

4.6 EXPOSURE ASSESSMENT

As explained in the previous sections, there is no existing exposure of receptors to the site contaminants due to hydrological and geographical factors. Vapors and airborne particulates are not expected to reach off-site human receptors in significant concentrations. Additionally, the population in close proximity to the site is served by a municipal water system and the direction of contaminated ground water migration is directly away from the closest off-site human receptors. Thus, they are not located in potential exposure pathways. Ambient air and ground water contaminant concentrations will be reduced to insignificant levels by the time they reach the nearest downwind and downgradient human receptor.

If sensitive ecological systems are in the exposure pathway, i.e., marsh and wetland habitats, there could be some potential degradation or alteration of the biotic communities.

Presence or absence of environmentally persistent contaminants has not been established. The above exposure assessment is based only on the available chemical analytical data, hydrological data developed in this phase of the investigation, and an interpretation of the U.S. Geological Survey topographic map of the area.

4.7 RISK CHARACTERIZATION

Due to hydrological and topographical factors, and spatial distribution of possible receptors, the site does not appear to pose any health risks. There is some potential for environmental impacts on aquatic and terrestrial biota if fragile ecological habitats are located in the area.

It should be noted that this assessment is based on minimal data. This investigation did not attempt to fully identify and characterize the extent of contamination, particularly in areas adjacent to the site.

Data gaps which would have to be addressed should a comprehensive risk assessment be required include analysis of semivolatile organic compounds, identification of specific receptors, and analysis of specific potential environmental impacts.

5.0 GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGIES

The purpose of this chapter is to discuss the General Response Actions and possible Remedial Technologies that may be used at the Union Chemicals site to mitigate the existing contamination problem. Although the initial qualitative risk assessment concludes there are no apparent risks to human health associated with site contaminants, it may be necessary to implement a remedial action at the site to mitigate contamination of environmental media, i.e., ground water, Noes Creek, and Arthur Kill, and/or to protect aquatic ecosystem downstream of the site. It is currently anticipated that the remedial technologies that will be evaluated and screened prior to developing remedial action alternatives would focus primarily on reduction of ground water contaminant levels and control of contaminant migration and discharge to Noes Creek. Additional remedial technologies, i.e., those relative to soil contamination, are discussed here for completeness.

5.1 CONTAINMENT

The remedial action technologies that will be evaluated under the Containment General Response Action include the following:

- o Capping specific site areas
- o Ground water barriers.

5.1.1 Capping Specific Site Areas

Capping would reduce surface water infiltration rates and also prevent the spread of contaminants by wind and surface water runoff, as well as provide a cover over the contaminated areas preventing direct contact by potential receptors. Capping methods may include the placement of clay and synthetic membranes along with a vegetated top cover over specific site areas.

5.1.2 Ground Water Barriers

Ground water barriers would decrease the rate of contamination migration from the site. These barriers include soil-bentonite or cement-bentonite slurry walls. Slurry walls may be constructed upgradient of the site to divert ground water flow, downgradient of the site to facilitate capture of contaminated ground water, or as a complete perimeter barrier to ground water flow. The success of these barriers depends on the constructors ability to construct a solid slurry wall of high integrity, the ability to key the slurry wall into a relatively impermeable formation at the bottom, and the compatibility of the slurry wall materials with the contaminants.

5.2. GROUND WATER PUMPING

Ground water pumping is a remedial technology that can be used alone, or in combination with capping, ground water barriers, and ground water treatment. It can be designed to simply limit the migration of the contaminant plume while removing contaminated ground water, or with recycling to provide for flushing of contaminants from both saturated and unsaturated soils.

Ground water pumping systems are developed and evaluated to optimize removal of contaminated ground water. Typical ground water pumping systems include a system of well points manifolded to a common pump, or individual larger diameter interceptor wells. The well design optimizes the well location and spacing based on hydrogeologic conditions to maximize the total contaminant production for recovery and/or treatment.

The pumping system delivers contaminated ground water to an on-site or off-site treatment system for treatment prior to discharge or injection of the treated water back into the aquifer^{or nearby stream}. The feasibility of designing and constructing an on-site treatment system will be evaluated as well as an evaluation made relative to pumping or hauling contaminated ground water to an approved off-site treatment facility, i.e., Publicly Owned Treatment Works (POTW) and/or a privately owned treatment system.

5.3 COLLECTION SYSTEMS

Remedial technologies that would be evaluated under the Collection System General Response Action would include:

Review Steps here.

- o Large diameter wells (receptor wells)
- o French drains
- o Open cut trench with pumping network.

5.3.1 Large Diameter Receptor Wells

Large diameter receptor wells would utilize gravity separation of ground water and free product in wells 12-inch to 36-inch in diameter. The system would employ a number of large diameter wells placed strategically over the site. Each system would include a submersible pump for lowering the water table and a scavenger pump that would retrieve the light organic fraction floating on the ground water surface. The water would be pumped to a treatment system and the product captured would be transferred to a recovery unit or storage tank for transport off site.

5.3.2 French Drains

French drains outfitted with collection sumps and pumps could be installed along the perimeter of the site to capture and remove contaminated ground water.

French drains are constructed by excavating a trench, lining the trench with a geotextile filter fabric, and backfilling the trench with gravel. Ground water flows into the drains and is conveyed to a collection sump for transport to a treatment system. Perforated pipe can be placed in the bottom of the trench to provide a more effective conduit for ground water flow and ultimate removal of the contaminated ground water.

The site topography, ground water elevations, depth of excavation, and in-situ soil permeability will require a thorough evaluation in determining the feasibility of using french drains as a remedial technology.

5.3.3 Open Cut Trench with Pumping

This remedial technology is similar to the french drain system except that the excavated trench will remain open for ease of operation and observation during pumping.

The relative advantages to this remedial technology is that there is no requirement for filter fabric, gravel backfill material, or perforated pipe. The feasibility of utilizing this method of ground water removal will depend to a large extent on the constructibility of the trench, the length of time the trench will have to remain open relative to personnel safety, and the depth of the trench.

5.4 DIVERSION

The Diversion General Response Action includes the evaluation of the following remedial technologies:

- o Grading and revegetation
- o Control of surface water.

5.4.1 Grading and Revegetation

Site grading would be considered. This would be to provide a uniform land surface that promotes good surface water drainage from the site areas.

Revegetation would consist of placing top soil, as necessary, seeding and mulching to establish a suitable vegetated growth media on the newly graded area. This would stabilize the soil cover and prevent wind and soil erosion caused by water.

5.4.2 Control of Surface Water

Surface water control would consist of controlling storm water run-on and runoff from the site area by placing collection and diversion channels at strategic site locations to collect surface run-on. Surface water control directly reduces the volume of water available for infiltration into the site, ultimately reducing the migration rate of contaminated ground water. It also reduces the chance of contamination migration caused by surface runoff.

5.5 COMPLETE REMOVAL

Complete removal is simply the physical removal of all contaminated soil from the site. The excavated material would be loaded onto trucks and hauled to an approved treatment and/or disposal facility.

5.6 PARTIAL REMOVAL

Partial removal of contaminated soil would be evaluated. This remedial technology can be used to selectively remove contaminated "hot spots," (areas which contain contaminants in excess of specified levels).

5.7 ON-SITE AND OFF-SITE TREATMENT

The on-site and off-site treatment technologies that will be evaluated would include:

- o Incineration
- o Biological treatment
- o Physical treatment methods.

5.7.1 Incineration

Contaminated soils can be decontaminated by incineration. Incineration, using a rotary kiln, is a proven but expensive technology for destroying organic materials by high temperature combustion. The organic contaminants most amenable to incineration are the volatile compounds. Incineration of contaminated soils may be accomplished on site using a mobile incinerator unit. Off-site incineration would require transportation of the contaminated soils to a licensed incinerator capable of handling the decontaminated soil.

5.7.2 Biological Treatment

Biological treatment would be evaluated relative to treating the contaminated ground water that would be collected. The contaminated ground water may be able to be introduced into biological wastewater treatment units where micro-organisms would assimilate the organic compounds and use them as a food substrate. The organics would be converted to a more stable inorganic form or to cellular biomass. Biological treatment may also be designed and implemented as an in situ operation.

This treatment technology may be used in combination with a physical treatment process such as air stripping, steam stripping or activated carbon adsorption.

5.7.3 Physical Treatment Methods

The physical treatment technologies that will be evaluated for possible use in treating the contaminated ground water would include:

- o Equalization
- o Air stripping
- o Steam stripping
- o Activated carbon adsorption.

5.7.3.1 Equalization

Equalization would be used to dampen flow and/or concentration fluctuations. Typically, treatment processes operate more effectively if wastewater composition and flow rate are fairly constant. Equalization basins and/or tanks increase the stability of treatment processes especially if they are sensitive to fluctuating contaminant concentrations. Such treatment processes include activated carbon adsorption and biological treatment. The only disadvantage is that an equalization basin, when used to dampen fluctuations in the flow rate, may require a large area or tank to handle peak flows.

5.7.3.2 Air Stripping

Air stripping is an effective method for removal of volatile organic contaminants from ground water. The volatile compounds are stripped from the water when large volumes of air are passed upwards through a packed column, while the contaminated water flows counter current over the packing material. While effective volatile contaminant removal is experienced with the use of this technology, inorganic and nonvolatile organic constituents remain untreated. The use of this process treatment technology would most likely require additional process treatment steps to further treat the contaminated water to specified concentration levels.

5.7.3.3 Steam Stripping

Steam stripping is a proven process which is generally used for removing volatile organic compounds from process or wastewaters. Steam stripping is typically conducted as a continuous operation in a packed tower or fractionating distillation column. As the contaminated groundwater passes down through the column, it contacts the vapors rising from the bottom of the column where the contaminated ground water is finally heated by the incoming steam to reduce the volatile components in the water.

Steam stripping would have to be compared technically and economically to air stripping to determine the relative efficiencies and costs of each. This

evaluation would be based on the ground water contaminant levels and degree of treatment that would be required.

5.7.3.4 Activated Carbon Adsorption

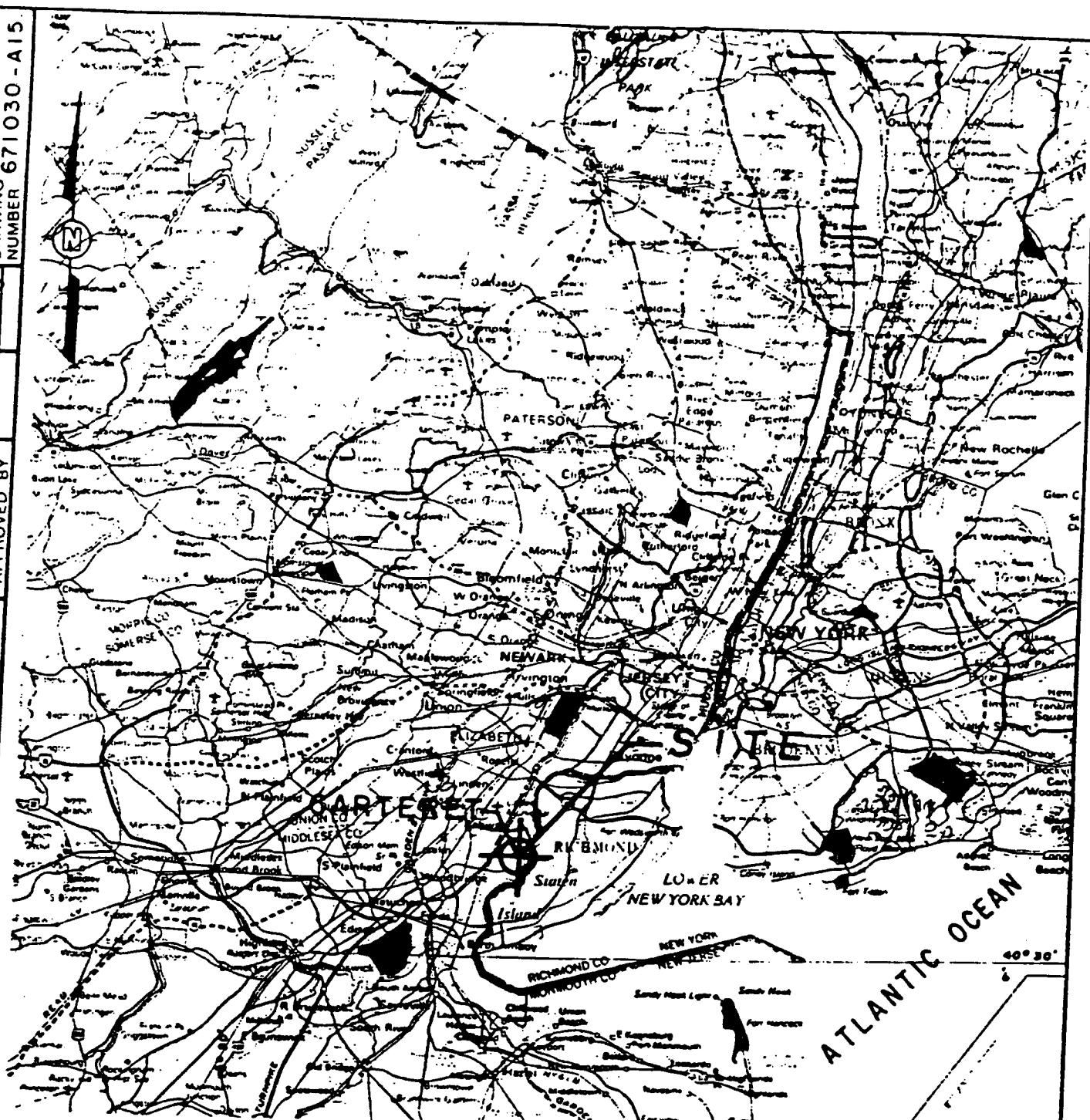
The activated carbon process has been widely used to remove a large number of organic contaminants. Carbon adsorption would involve contacting the contaminated ground water with activated carbon, which adsorbs the contaminants in the water. When the carbon reaches its ultimate capacity for adsorption, it is removed from the containment canisters for disposal, destruction, or regeneration.

The suitability of carbon adsorption for the treatment of contaminated ground water will depend on the type of contaminants, the extent of pretreatment necessary, and the required effluent quality.

Activated carbon has been proven effective for the removal of a variety of chlorinated hydrocarbons, organic phosphorus, PCBs, phenols, aromatic hydrocarbons, and some heavy metals. It is also effective for taste and odor control and color removal.

FIGURES

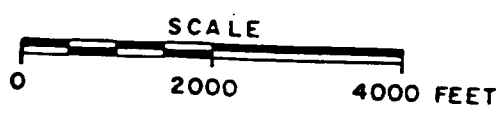
DRAWN BY: ALOBRECIO 10-24-88
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REFERENCE:
 THE NATIONAL ATLAS OF THE
 UNITED STATES OF AMERICA.
 BY: UNITED STATES - DEPARTMENT
 OF THE INTERIOR-GEOLOGICAL SURVEY.
 DATED: 1970 SCALE: 1: 500, 000

FIGURE I

SITE LOCATION MAP



PREPARED FOR

**UNION CHEMICALS
 CARTERET, NEW JERSEY**



TABLES

TABLE 1
SURFACE WATER ANALYSES SUMMARY

PARAMETER	SAMPLE IDENTIFICATION		
	U-1W(a) (water layer)	U-1W(a) (oil layer)	U-4(b)
<u>VOLATILE PRIORITY POLLUTANTS (ppb)</u>			
Benzene	8,200	1,000,000 ^{1 PPT}	14,000
Chlorobenzene			37,000
Methylbromide		3.6 PPT	1,400
Toluene	7,700	3,600,000	640
<u>VOLATILE NONPRIORITY POLLUTANTS (ppb)</u>			
4-Methyl-2-pentanone			2,700
Styrene		64 PPT	690
Total xylenes	100,000	64,000,000	610

(a) Water sample collected near first seep.

(b) Water sample collected from bottom valve of vacuum truck.

TABLE 2
SOIL ANALYSES SUMMARY

PARAMETER	SAMPLE IDENTIFICATION		
	U-2S(a)	U-TP-2(b)	U-TP-4(c)
<u>VOLATILE PRIORITY POLLUTANTS (ppb)</u>			
Benzene	200	64	33
Chlorobenzene		950	650
1,1-Dichloroethane		74	-
Ethylbenzene		17	69
Methylene Chloride		160	77
Tetrachloroethylene		2,100	19
1,1,1-Trichloroethane		510	-
Trichloroethylene		85	-
<u>VOLATILE NONPRIORITY POLLUTANTS (ppb)</u>			
Acetone		240	-
Total xylenes	440	120	520

*Many VOC's are
not adsorbed
onto soils.*

- (a) Surface soil sample collected near first seep.
(b) Composite soil sample collected in Test Pit No. 2.
(c) Composite soil sample collected in Test Pit No. 4.

Prod
water

I would like to know the criteria used for determining the depths of these borings!

ALT for all wells
~ +9.5' ± 1.5'

Discrepancies between App. A+B (bottom of boring).

* - these borings probably should have gone deeper for better (complete) vertical definition of plume.

TABLE 3
RESULTS OF MEASUREMENTS FOR VOLATILE ORGANICS OF SOIL
SAMPLE BOTTLE HEADSPACE REGION
(PPM from OVA)

BORING NUMBER	B-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12
S-1 2'	<1.0	0	3	100	100	300	1,000	250	500	>1,000	45	>1,000
S-2 4'	90	300	950	>1,000	450	>1,000	650	>1,000	>1,000	>1,000	>1,000	>1,000
S-3 6'	100	850	>1,000	350	>1,000	>1,000	240	>1,000	>1,000	>1,000	400	>1,000
S-4 8'	>1,000	450	>1,000	100	>1,000	(a)	240	>1,000	>1,000	>1,000	650	>1,000
S-5 10'	1,000	110	200	420	950	>1,000	200	>1,000	>1,000	>1,000	>1,000	>1,000
S-6 12'		75	60	800	950	>1,000	450	>1,000	>1,000	>1,000	900	>1,000
S-7 14'		250	15	MISSING	BoB	>1,000	100	>1,000	>1,000	>1,000	700	>1,000
S-8 16'		20		BoB	10	>1,000	100	>1,000	>1,000	>1,000	50	BoB
S-9 18'		50		BoB	14?	>1,000	10	>1,000	250	BoB	140	BoB
S-10 20'		0				>1,000	60	>1,000				103
S-11 22'		10					950	BoB	BoB			
S-12 24'		50						BoB	BoB			
S-13 26'		10						BoB	BoB			
S-14 28'		5						BoB	BoB			
S-15 30'		15						BoB	BoB			

FWT adjacent to MW-2 - ok
to delete from analysis why? boring so close

almost same location!!

why stop here? why not go deeper?

Why are wells sample so clean?

Every boring had an OVA reading

BoB, 1,000, cgt
MW-11, 12

(a) Insufficient sample collected to measure.

Screen (BLS)

MW1

4-10
10' boring

12-30
~~12-30~~

2-8

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4-16

26-32

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3-15

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TABLE 4
MONITORING WELL ELEVATIONS(a)

MONITORING WELL	TOP OF COVER	TOP OF INSIDE PIPE	BOTTOM OF WELL
MW-1	8.98	8.27	-1.02
MW-2	8.47	7.91	-21.53
MW-3	9.31	8.87	-4.69
MW-4	9.30	8.68	1.30
MW-5	9.16	8.90	1.16
MW-6	8.84	8.60	-7.16
MW-7	8.83	8.24	-23.17
MW-8	9.43	8.82	4.57
MW-9	10.40	9.89	-4.60
MW-10	10.83	10.32	2.83
MW-11	11.25	10.70	3.25
MW-12	12.48	12.10	4.48

(a) Elevations in feet (msl).

TABLE 5
GROUND WATER ELEVATIONS

gradient

MONITORING WELL NO.	9-17-85/07:50(a)	9-17-85/14:20(b)	10-7-85/10:00(c)	10-7-85/16:15(d)	10-15-85/12:30(e)
< 1 <i>sk</i>	2.69	3.10			
2 <i>De</i>	3.45 <i>up</i>	3.33 <i>up</i>	4.52	2.52 <i>L ON</i>	4.89 <i>H DN</i>
3	5.45 <i>L</i>	6.24	4.16 <i>DN</i>	2.16 <i>L</i>	4.78 <i>H</i>
4	5.51	5.91	6.54	5.87	6.56 <i>H</i>
5	3.15 <i>L</i>	3.65	6.35	6.18	6.90 <i>H</i>
< 6 <i>sk</i>	3.60 <i>DN</i>	4.18 <i>DN</i>	3.57	3.40	4.80 <i>H</i>
7 <i>De</i>	2.86 <i>L</i>	3.16	4.45 <i>DN</i>	3.10 <i>L UP</i>	4.83 <i>H DN</i>
8	4.53 <i>L</i>	5.49	4.16	3.24	4.70 <i>H</i>
9	7.39 <i>L</i>	7.89	5.66 <i>H</i>	5.03	5.02
10	6.07	8.11	8.31	8.16	8.46 <i>H</i>
11	8.20 <i>L</i>	9.20	8.57	8.69	8.77 <i>H</i>
12	8.60 <i>L</i>	9.93	9.91 <i>H</i>	9.89	9.47
			10.93 <i>H</i>	10.89	10.44

- (a) High tide at Sandy Hook, NJ 9-17-85 was at 09:24.
 (b) Low tide at Sandy Hook, NJ 9-17-85 was at 16:00.
 (c) High tide at Sandy Hook, NJ 10-7-85 was at 13:11.
 (d) Low tide at Sandy Hook, NJ 10-7-85 was at 20:18.
 (e) Low tide at Sandy Hook, NJ 10-15-85 was at 14:38.

L = lowest well
H = highest well

Note: All elevations in feet (msl).

in some for the fire 6/10/1

should have been sampled @ bottom, given MW-1T

when is 5B??

with no shell sand

TABLE 6
GROUND WATER ANALYSES SUMMARY

PARAMETER	MW-1T	MW-2T	MW-3T	MW-4T	MW-5T	MW-6T	MW-7T	MW-8T	MW-9T	MW-10T	MW-11T	MW-12T
Volatile Priority Pollutants (ppb)												
1 Benzene .88	7.3	22	22	2,200	2,500	49,000	85,000	320	17,000	1,500	1,500	1,500
2 Chlorobenzene 1.1	17	150	41	4,200	23,000	230,000	150,000	2,000	140,000	130,000	1,500	1,500
Chlorodibromomethane	-	-	-	-	-	-	-	-	-	-	-	-
6 Chloroethane	-	6.8	25	1,600	55	-	4.1	2.7	140,000	130,000	1,500	1,500
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-
7 1,1 Dichloroethane	2.5	46	4.2	120	12	-	2.5	12	65	65	13	61
1,2 Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
1,1 Dichloroethylene	-	8.6	-	-	-	-	-	2.4	-	-	-	-
8 1,3 Dichloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
3 Ethylbenzene .87	-	-	-	64	-	-	-	-	-	-	-	-
9 Methylene Chloride 1.33	-	-	-	280	2,700	-	2,600	230	1,400	1,800	300	44
1,1,2,2-Tetrachloroethane	-	-	-	-	-	630	21	-	-	-	-	-
10 Tetrachloroethylene 1.62	-	1.0	-	-	15	-	-	-	-	-	-	-
4 Toluene .87	1.0	6.6	-	2.8	-	200	320	-	-	-	-	-
Trans-1,2 Dichloroethylene 1.28	-	2.8	1.3	62	1.0	640	76	2.4	280	220	220	2.1
1,1,1-Trichloroethane	-	87	54	44	-	-	4.1	450	330	280	13	118
Trichloroethylene	-	2.2	-	-	-	-	-	-	-	-	-	-
Vinyl Chloride	-	-	-	15	-	-	10	-	-	-	-	-
Volatile Non Priority Pollutants (ppb)												
1,2,3,4,5-Aliphatic (7, 8, 10, 11, 12)	2.5	6	-	5	-	3	4	14	2	13	-	-
Acetone	-	137	59	308	13	940	411	453	1600	176	10	6
2-Butanone	-	-	-	16	28	-	-	63	21	-	-	-
Carbon disulfide	13	18	-	-	100	-	-	62	89	-	-	-
4-Methyl-2-pentanone	-	-	-	46	-	-	-	-	-	-	-	-
Styrene	-	-	-	26	-	-	-	-	-	-	-	-
5 Xylenes, Total ~.87	-	-	-	7.6	39	-	-	-	-	-	-	-
SUM 1-5 (APPROX. TOT. VOC)	-	-	-	920	4,300	2,200	24,000	890	1,500	1,500	1,500	1,500
Other Parameters (ppm)	25	178	63	10,400	33,270	293,200	246,300	8,177	16,400	51,000	18,000	18,000
Total Organic Carbon	14	6	82	23	28	48	30	15	15	18	15	15
Total Organic Halogen	0.38	0.15	0.14	1.5	13	73	26	3.10	1.8	1.8	1.8	1.8
Alkalinity	460	-	-	-	380	-	-	-	-	-	-	-
Chloride	180	-	-	-	290	-	-	-	-	-	-	-
Sulfate	60	-	-	-	3	-	-	-	-	-	-	-
Field pH	6.0	6.6	6.7	6.6	6.5	6.6	6.5	6.6	6.6	6.6	6.6	6.6
Field Specific Conductance (umhos/cm @ 25°C)	470	310	590	460	1300	220	1600	480	510	510	510	510
Field Temperature (°C)	23	23	23	26	23	22	23	23	23	23	23	23

If product was seen on top, then these two samples should not look as similar as they do! Problem with sampling with sample notice that B is higher in well than T for both samples!

TABLE 7
PERMEABILITY TEST RESULTS

<u>WELL</u>	<u>PERMEABILITY</u> (cm/sec)	<u>SOIL TYPE</u>
MW-1	2.1×10^{-4}	Silty clay
MW-4	1.3×10^{-5}	Sand/silty clay
MW-6	1.2×10^{-4}	Fill
MW-7 <i>deep</i>	7.7×10^{-4}	Sand/silty clay
MW-12	3.5×10^{-3}	Sand/silty clay

Silt to silty-sand
range. good
2y. fine.

M SEDIM

ts

TABLE 8
STREAM SEDIMENT ANALYSES SUMMARY

PARAMETER	SAMPLE IDENTIFICATION	
	NC-D	NC-U
<u>Priority Pollutants</u>		

b)

None Detected

Priority Pollutants

b)

None Detected

ers

n)

Carbon
Halogen

3500	3300
0.40/0.46	0.74

FREQUENCY OF
POSITIVE DETECTIONS
(NO. OF +/NO. OF SAMPLES)

OBSERVED
RANGE
(min./max.)

REMARKS

TABLE 9
SELECTION OF INDICATOR CONTAMINANTS

LIST OF TABLES

<u>TABLE NO.</u>	<u>TITLE</u>
1	Surface Water Analyses Summary
2	Soil Analyses Summary
3	Results of Measurements for Volatile Organics of Soil Sample Bottle Headspace Region
4	Monitoring Well Elevations
5	Ground Water Elevations
6	Ground Water Analyses Summary
7	Permeability Test Results
8	Stream Sediment Analyses Summary
9	Selection of Indicator Contaminants

LIST OF FIGURES

<u>FIGURE NO.</u>	<u>TITLE</u>
1	Site Location Map
2	Location of Sampling and Testing Sites
3	Generalized Hydrogeologic Cross Section A-A'
4	Generalized Hydrogeologic Cross Section B-B'
5	Generalized Hydrogeologic Cross Section C-C'
6	Generalized Ground Water Contour Map